

ENGINE COOLING SYSTEM CONTROL APPARATUS FOR VEHICLES AND METHOD THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority of Korean Application No. 10-2003-0065368, filed on September 20, 2003, the disclosure of which is incorporated fully herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to an engine cooling system control apparatus for vehicles and method thereof and, more particularly, to an engine cooling system control apparatus for vehicles and method thereof configured to optimally control a coolant temperature and to prevent thermal shock of a cooling system.

BACKGROUND OF THE INVENTION

[0003] Generally, water-cooled cooling systems for vehicles are configured such that engine cooling water is ejected from a water pump to sequentially pass through a cylinder block of an engine and a cylinder head to absorb heat from the engine, and is discharged via an outlet in the cylinder head to pass through a heater or a radiator for transfer of the heat. The cooling water is again introduced into the cylinder block via the water pump for circulatory cooling operation. Furthermore, an outlet of an engine is equipped with a thermostat that opens and closes in relation to the cooling water temperature to switch a circulatory route of cooling water.

[0004] However, there are drawbacks to the cooling system according to the prior art thus described in that a circulatory route of cooling water is switched with a predetermined temperature as a starting point regardless of the load condition of the engine. The prior art cooling system causes a sudden flow of water when the thermostat

opens to allow cooling water flow through the engine, resulting in a cooling water temperature drop for a preset time, making it impossible to control the cooling water temperature at a constant optimal level and causing thermal shock. This sudden opening and closing of the thermostat also creates inaccuracy in measuring cooling water temperature.

SUMMARY OF THE INVENTION

[0005] Embodiments of the present invention provide an engine cooling system control apparatus for vehicles and a method thereof configured to optimally control cooling water temperature in response to the load condition of an engine and to prevent a thermal shock and inaccuracy in measuring cooling water temperature.

[0006] In accordance with a preferred embodiment of the present invention, an engine cooling system control apparatus in an engine cooling system configured to pump cooling water from a water pump to sequentially pass through an engine and a radiator for cooling the engine, comprises electronic valve means for adjusting the amount of cooling water circulating via the radiator. A thermometer detects the temperature of the cooling water as it leaves the engine. A controller controls the operation of the electronic valve means in response to the cooling water temperature detected by the thermometer to maintain an established target temperature.

[0007] In accordance with another embodiment of the present invention, the method for controlling an engine cooling system for vehicles configured to pump cooling water from a water pump to sequentially pass through an engine and a radiator for cooling the engine, comprises: (a) determining an operating load in response to a throttle position of an engine and engine revolutions per minute (RPM); (b) determining a pre-set temperature in response to the operating load; (c) comparing the pre-set

temperature with a cooling water temperature; and (d) controlling the operation of the electronic valve means in response to the comparative result of the two temperatures to control the amount of circulating cooling water.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate an embodiment of the invention, and together with the description, serve to explain the principles of the invention.

[0009] FIG. 1 is a schematic drawing of an engine cooling system for vehicles according to an embodiment of the present invention; and

[0010] FIG. 2 is a flow chart illustrating the operating process of the controller of FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

[0011] The preferred embodiment of the present invention will now be described in detail with reference to the accompanying drawings.

[0012] A preferred embodiment of an engine cooling system for vehicles, as illustrated in FIG. 1, includes a first circulatory route wherein cooling water of an engine 2 is pumped from a water pump 1 to pass through a cylinder block and a cylinder head of the engine for absorption of heat generated by the engine 2. The cooling water then passes through a heater core 3 and is introduced into the water pump 1. The preferred embodiment includes a second circulatory route wherein the cooling water is pumped from a water pump 1 to pass through a cylinder block and cylinder head for absorbing the heat of the engine and then passes through a radiator 4 for discharging the heat. Finally, the cooling water is re-introduced into the cylinder block of the engine 2 via the water pump 1.

[0013] In the first circulatory route, the cooling water flows at all times, and the amount of cooling water circulating therein is so little that the effect on cooling water temperature is minimal. Meanwhile, the amount of cooling water flowing in the second circulatory route is adjusted by electronic valve means 10, 11 and 12.

[0014] The radiator 4 includes cooling fan means 5 for blowing air when the cooling water exceeds a predetermined temperature to improve a heat exchange performance of the radiator 4, and an outlet thermometer 6 for detecting the temperature of the cooling water at an outlet side of the engine 2 to produce a temperature signal. A controller 20 controls the electronic valve means 10, 11 and 12, where the electronic valve means includes a valve 10, a motor 11 and a motor driving part 12.

[0015] The valve 10 is operated by application of power, generated by the motor 11.

[0016] For example, the motor 11 is preferably a stepping motor where detection of rotating position is unnecessary and a rotor is moved to a predetermined position in response to an input signal. The motor driving part 12 applies power to the motor 11 in response to a signal from the controller 20 and drives the motor.

[0017] The controller 20 determines the operating load of the engine 2 in response to a throttle position value input from a throttle position sensor (not shown) of the engine 2 and an engine RPM detection value input from a tachometer (not shown), and determines the temperature of cooling water at an outlet side of the engine 2 in response to a temperature signal input from the outlet thermometer 6.

[0018] Furthermore, the controller 20 determines the circulatory route of the cooling water and the valve 10 opening level in response to the operating load thus determined and the cooling water temperature at the outlet side to generate a control

signal for operating the valve 10 in response thereto and sends the control signal to the motor driving part 12.

[0019] The control signal generated by the controller 20 is preferably a Pulse Width Modulation (PWM) signal.

[0020] Next, the operating process of the present invention thus constructed will be described with reference to the accompanying drawings, where S denotes a step.

[0021] First, the controller 20 calculates the throttle position value input from the throttle position sensor (not shown) of the engine 2 and the engine RPM value input from the engine tachometer (not shown) to obtain an operating load value of the engine 2 (S10), and determines whether the operating load of the engine 2 is a pre-set full load operating condition or a pre-set intermediate load operating load (S20).

[0022] As a result of the determination at S20, if the operating load is the full load operating condition, the controller 20 determines a target temperature as a first set temperature (T1) (*e.g.*, approximately 90 degrees Celsius) and detects a current cooling water temperature at the outlet side of the engine 2 in response to a signal input from the outlet thermometer 6 to compare same with the first set temperature (T1) (S30).

[0023] If the cooling water temperature is below the first set temperature (T1) as determined by the comparison at S30, the controller 20 maintains the valve 10 in a closed position and the cooling fan means 5 in an OFF state, as the cooling water temperature is relatively low and there is no need for circulation of the cooling water through the radiator 4 (S40).

[0024] If the current water temperature is higher than the first set temperature (T1) as determined by the comparison at S30, the controller 20 generates a control signal to the motor driving part 12 to drive motor 11 to open the valve 10 to a pre-set

valve opening level (A), and drives the cooling fan means 5 at a low speed (S50), where flow advances to a below-mentioned valve opening and closing level proportional integral (PI) control step (S80).

[0025] The motor driving part 12 activates the motor 11 in response to the control signal of the controller 20 to thereby open the valve 10 to an opening level A. The opening level of the valve 10 causes the cooling water in the engine to be discharged from the water pump 1, and the cooling water sequentially passes through a cylinder block and cylinder head of the engine 2 for absorbing the heat of the engine. The cooling water is discharged via an outlet of the cylinder head to discharge the heat via the radiator 4, and is again introduced into the cylinder block of the engine 2 via the water pump 1 for circulatory cooling.

[0026] By way of reference, the valve opening and closing level A is a pre-set value having a smaller amount of cooling water circulating than that of the valve opening and closing level B (described later).

[0027] Meanwhile, as a result of the determination at S20, if the operating load condition of the engine 2 is not the full load operating condition but an intermediate load operating condition, the controller 20 chooses a target temperature as a second set temperature (T2, e.g., 110 degrees Celsius) and detects a current cooling temperature at the outlet side of the engine 2 in response to the signal from the outlet thermometer 6 to compare same with the second set temperature (T2) (S60).

[0028] If the current outlet temperature of the engine 2 is below the second set temperature (T2) as determined by the comparison at S60, the controller 20 maintains the valve 10 in the closed position, where the flowchart advances to S40 for maintaining

the OFF state of the cooling fan means 5 because the cooling temperature is relatively low and cooling water circulation is not required.

[0029] As a result of the comparison at S60, if the current outlet temperature of the engine 2 is higher than the second set temperature (T2), the controller 20 generates a control signal for opening the valve 10 to a pre-set valve opening and closing level to send same to the motor driving part 12, and simultaneously drives the cooling fan means 5 at a low speed (S70), where the flowchart advances to the below-mentioned valve opening and closing level (PI) control step (S80).

[0030] The motor driving part 12 drives the motor 11 in response to the control signal from the controller 20 to open the valve 10 up to the valve opening and closing level (B), and the cooling water of the engine is forced out from the pump 1 in response to the opening level of the valve 10. The cooling water then sequentially passes through the cylinder block and the cylinder head to absorb the heat of the engine. The cooling water is then discharged via the outlet of the cylinder head to discharge the heat via the radiator 4 and is returned to the cylinder block of the engine 2 via the water pump 1 to carry out the circulatory cooling process.

[0031] By way of reference, the valve opening and closing level B is larger than the aforementioned valve opening and closing level A in terms of allowing flow of cooling water.

[0032] Next, the controller 20 accurately increases or reduces the valve opening and closing level via a PI control that uses the current engine temperature and the pre-set temperature (T1 or T2) as input parameters, whereby the cooling water temperature can be optimally maintained to meet the targeted pre-set temperature (T1 or T2) (S80).

[0033] At the same time, the controller 20 compares the current cooling temperature with a summed-up value where the pre-set temperature (T1 or T2) is added to a pre-set temperature aggravated value (e.g., approximately 30 degrees Celsius) (S90).

[0034] As a result of the comparison at S90, if the current cooling water temperature is larger than the summed-up value, the controller 20 rotates the cooling fan means 5 at a high speed to increase the heat exchange performance of the radiator 4 because the current cooling water temperature is fairly high, necessitating greater cooling performance (S100).

[0035] As a result of the comparison at S90, if the current cooling temperature is below the summed-up value, the controller 20 re-compares the current cooling temperature with the first set temperature (T1) (S110).

[0036] As a result of the comparison at S110, if the current cooling temperature exceeds the first set temperature (T1), the controller 20 returns to the valve opening and closing level PI control step (S80), and if the current cooling temperature is less than the first set temperature (T1), the flowchart returns to S10 for determining the operating load.

[0037] Although the preferred embodiments of the present invention have been disclosed for illustrative purpose, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

[0038] As apparent from the foregoing, there is an advantage in the engine cooling system control apparatus for vehicles and a method thereof thus described according to the present invention in that cooling water flow can be accurately adjusted in response to operating load conditions and temperature of an engine, thereby allowing

optimal control of cooling water temperature in response to the load conditions of the engine and preventing thermal shock and instability in cooling operation.